Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

# AVIATION INVESTIGATION REPORT
# A08W0151

## LOSS OF SEPARATION

## NAV CANADA – EDMONTON AREA CONTROL CENTRE
## FORT McMURRAY, ALBERTA, 30 nm SW
## 30 JULY 2008

Canada

# Aviation Investigation Report

# Loss of Separation
# NAV CANADA – Edmonton Area Control Centre
# Fort McMurray, Alberta, 30 nm SW
# 30 July 2008

# Report Number A08W0151

## *Summary*

An Air Mikisew Jetstream 3100, flight AM 304, had departed Edmonton, Alberta's City Centre Airport en route to Fort McMurray, Alberta (CYMM). A WestJet Boeing 737, flight WJA 255, had departed Edmonton International Airport also en route to Fort McMurray. Due to a line of thunderstorms southwest of Fort McMurray, several aircraft, including AM 304 and WJA 255, were cleared by air traffic control to deviate around thunderstorms as required. WJA 255 was cleared to 9000 feet above sea level (asl) and was following on a parallel course with AM 304, which was cleared to descend to 7000 feet asl. At 1834 mountain daylight time, approximately 30 nautical miles (nm) southwest of CYMM, AM 304 deviated towards WJA 255, which was now at a similar altitude. This resulted in a decrease of separation to 1.4 nm and 100 feet where 5 nm or 1000 feet was required. As a result, WJA 255 responded to a traffic alert and collision avoidance system resolution advisory to climb.

*Ce rapport est également disponible en français.*

# *Other Factual Information*

## *Specialty Description and Staffing Levels*

The Edmonton Area Control Centre North Low Specialty was comprised of seven sectors: McMurray, Inuvik, Peace River, Slave Lake, Uranium, Whitehorse, and Yellowknife. (see Appendix A – North Low Sector Map). The specialty provides air traffic services for the airspace below flight level (FL) 290 [1]. On the day of the occurrence, the specialty was staffed to required levels. At the time of the occurrence, the McMurray, Peace River, and Slave Lake sectors were combined and staffed by both a radar and data controller.

Four airports in the Fort McMurray sector are served by both scheduled and charter air operators using medium-sized jet aircraft. These airports account for upwards of 75 000 aircraft movements per year. The sector abuts a large area of restricted military airspace surrounding Cold Lake, which can reduce the options available to controllers for deviations and traffic management.

At the time of the occurrence, workload was described as moderate but complex due to thunderstorm activity to the south and west of Fort McMurray Airport and the consequent requests for deviations.

## *Controller Background*

The occurrence controller was certified and qualified to work the McMurray sector by way of partial check-out completed in January 2008. This phased approach was utilized given the wide range of disciplines required in the North Low Specialty. First, the controller would be checked out on the McMurray, Peace River, Uranium, and Slave Lake sectors, which are primarily radar sectors. Then, while maintaining currency in those sectors, the controller would continue training in the Yellowknife, Whitehorse, and Inuvik sectors, which are primarily procedural or non-radar sectors. This technique was used to ensure that the competency levels achieved for the radar sector did not atrophy during training for the non-radar sector.

To facilitate the Yellowknife sector on-job training, the controller had been working a schedule that would accommodate various on-job-instructors' (OJI) timetables. This resulted in a fairly consistent schedule in July, where the controller was working primarily weekdays with little overtime and no night shifts. On the day of the occurrence, the controller started the shift in a training session in the Yellowknife sector at 1258 mountain daylight time [2]. The controller spent the first four hours (one hour on, one hour off, two hours on) of the scheduled shift in training. After starting a 30-minute break, the controller was recalled, at 1810, to take over the McMurray data position. Shortly thereafter, the controller took over the McMurray radar position. This was due to an alleged operating irregularity involving another controller in the specialty. The controller then moved to the radar position at 1819, remaining there until the occurrence.

---

1 Approximately 29 000 feet above sea level

2 All times are mountain daylight time (Universal Coordinated Time minus six hours).

The controller had earlier been notified by the supervisor that a required over-the-shoulder check (OTS) would be completed on the McMurray sector at some point during the shift. Just prior to the occurrence, the supervisor plugged his headset into the controller's console to start the OTS check. It was while the supervisor and the data controller were discussing a data issue that the loss of separation occurred.

The controller had recently completed annual recurrent training on the traffic alert and collision avoidance system (TCAS) with the completion of a computer-based training module. The module emphasized that control instructions that would contradict an aircraft's resolution advisory or warning shall not be given, but that relevant traffic information and collision avoidance advice may be given as appropriate.

## *Weather*

Northern Alberta was under the influence of an unstable air mass which produced intense thunderstorm activity. As a result, SIGMET A2 [3] was issued for north-eastern Alberta which described a line of thunderstorms on radar in the Fort McMurray area with tops from FL 350 to FL 400. The SIGMET was valid from 1810 to 2210. Satellite imagery of this area also showed strong convective activity at the time of the occurrence. The Environment Canada lightning detector recorded multiple lightning strikes throughout this area.

## *Description of Events*

From the time the controller took over the radar position at 1819 to the time of the loss of separation at 1834, Runway 07 was active at Fort McMurray (CYMM). There were four arrivals for CYMM and one arrival for Peace River (CYPE), Alberta. All arrivals for CYMM were requesting and receiving approval for deviations for weather. Three of the arrivals were deviating to the west and one arrival was able to break through the weather by deviating to the east. There were four departures from CYMM in that time and all were heading south. Only one of the departures requested a deviation.

---

[3] Significant Meteorological Information, series A, number 2

The three arrivals for CYMM that were deviating to the west were AM 304 (Jetstream 31), CPB 502 (Saab 340), and WJA 255 (Boeing 737). The controller had issued "deviate as required" clearances to these three aircraft with no limitations in terms of direction of turn or amount of heading change. The controller's plan to ensure the required separation was to use vertical spacing and knowledge of expected aircraft rates of descent (1500 feet per minute (fpm) for the Jetstream 31). Post-occurrence analysis of the event showed that AM 304 needed a minimum descent rate of 1160 fpm to achieve 1000 feet of separation from WJA 255 by the time WJA 255 overtook them (see Appendix B - Descent Profiles). Throughout most of the descent, all three aircraft maintained fairly parallel courses.

**Instrument Flight Rules – En Route Procedures, Climbs and Descents**

The Transport Canada *Aeronautical Information Manual* (AIM) TP 14371, section RAC 8.5.1 (a), advises that a pilot should begin a climb or descent promptly and that the climb or descent should be made at an optimum rate consistent with the operating characteristics of the aircraft. If the pilot is unable to comply, they should advise air traffic control.

All three aircraft were descending and were issued successively lower altitudes to descend to. WJA 255 had a faster ground speed and, because CPB 502 would be the first aircraft overtaken, the controller was ensuring that WJA 255's cleared altitude was always above that of CPB 502's vacated altitude. At approximately 1829, AM 304 was cleared to 7000 feet asl when it was about 16 nautical miles (nm) ahead of WJA 255 and 11 nm ahead of CPB 502 (see Appendix C – Plan Views). Vertical separation between AM 304 and WJA 255 was 3600 feet and WJA 255's ground speed was about 130 knots faster than AM 304. By 1831:30, WJA 255 overtook CPB 502 and was now 2400 feet above AM 304 and 10 miles in trail and tracking parallel six nm to the west of AM 304 (see figure C, Appendix C – Plan Views). At 1833, WJA 255 was descending through 12 200 feet and was cleared to 9000 feet. AM 304 was descending through 11 400 feet and the rates of descent for WJA 255 and AM 304 remained consistent at approximately 1730 fpm and 970 fpm. By 1833:30, WJA 255 had reached AM 304's altitude and was six nm southwest. Over the next 45 seconds, AM 304 altered course 60° to the left for weather. AM 304 did not broadcast its intentions or request the deviation because it had previously been cleared to deviate as required. At 1834:44, WJA 255 reported level at 9000 feet. The controller did not acknowledge the report.

The required separation of five nm lateral or 1000 feet vertical was lost at 1834:15 when WJA 255 and AM 304 were less than five nm apart laterally and 200 feet vertically, with both aircraft still in descent. The closest approach of the two aircraft came at 1835:08, when they were 1.4 nm apart with 100-foot vertical spacing. WJA 255 was at 9100 feet climbing in response to a traffic alert and collision avoidance system resolution advisory (TCAS RA) and AM 304 was at 9200 feet starting a controller-requested climb.

The radar situation display (RSiT) has the capability to display conflict alerts. However, NAV CANADA requires the disabling of this feature below 14 000 feet in order to reduce the number of false alerts.

## *Pilot and Controller Actions during TCAS Manoeuvres*

The converging courses of WJA 255 and AM 304 went unnoticed by the controller until, at 1834:58, the controller instructed AM 304 to climb to 10 000 feet. At this time (which was while the WJA 255 flight crew were dealing with a passenger medical situation) the WJA 255 TCAS generated a TCAS RA CLIMB command. The flight crew advised the controller that they had a TCAS RA but did not advise whether they were climbing or descending as directed in section RAC 12.15.8 of the AIM. The controller instructed WJA 255 to turn 40º to the left, but the flight crew did not immediately comply, nor were they required to as indicated in CARS 602.31(4). At the time the clearance to climb was given to AM 304, AM 304 was still in descent out of 9300 feet. It took AM 304 approximately 25 seconds to achieve a positive rate of climb, by which time the two aircraft were ½ nm apart and WJA 255 was already climbing through 10 000 feet. For approximately 30 seconds, both aircraft were climbing and separation was regained at 1835:37 when WJA 255 achieved 1000 feet of vertical separation from AM 304. At 1835:47, WJA 255 levelled at 11 000 and turned left 40º. The occurrence controller was relieved from the position by the sector supervisor at 1837.

The provision of collision avoidance information varies between the NAV CANADA MANOPS [4], Document 4444, published by the International Civil Aviation Organization (ICAO), and Transport Canada (TC) publications.

> **NAV CANADA ATC MANOPS 127.2** Provide relevant traffic information and collision avoidance advice as appropriate to an aircraft under your jurisdiction if you are advised by the aircraft that it is responding to an airborne collision avoidance system (ACAS)/TCAS resolution advisory or GPWS/TAWS [5] warning. Do not issue control instructions that would contradict an aircraft's resolution advisory or warning.
>
> **TC AIM RAC 12.15.8 (d)** When a pilot reports a manoeuvre induced by an RA, the controller should not attempt to modify the aircraft fight path until the pilot reports returning to the terms of the existing ATC instruction or clearance, but should provide traffic information as appropriate.
>
> **ICAO Doc 4444 (ATM/510) - Procedures for Air Navigation Services Air Traffic Management section 15.7.3.2** When a pilot reports a manoeuvre induced by an ACAS resolution advisory (RA), the controller shall not attempt to modify the aircraft flight path until the pilot reports returning to the terms of the current air traffic control instruction or clearance but shall provide traffic information as appropriate.

---

4 Manual of operations

5 GPWS – Ground proximity warning system; TAWS – Terrain awareness and warning system.

## *Safety Alert Phraseology*

When the controller observed the proximity of WJA 255 to AM 304, safety alert phraseology was not used when AM 304 was instructed to maintain 10 000 feet, nor was traffic information passed to either aircraft as to their proximity or relative position to one another.

On 05 February 2004, NAV CANADA issued Air Traffic Services (ATS) Bulletin NP 8493 on imperative phraseology as a response to several Transportation Safety Board of Canada investigations. The bulletin identified the necessity to use clear and concise phraseology to convey a sense of urgency. In addition, an urgent ATS Operational Publication Change was issued outlining the new phraseology to be used.

> MANOPS 507.1 Safety Alert states:
> Issue a safety alert to an aircraft if you are aware the aircraft is at an altitude which, in your judgment, places it in unsafe proximity to the terrain, an obstruction or another aircraft. Suggested phraseology for aircraft proximity: CLIMB/DESCEND (specific altitude, if appropriate) IMMEDIATELY - or - TURN LEFT/RIGHT IMMEDIATELY HEADING (number) TO AVOID [UNIDENTIFIED] TRAFFIC (bearing by clock-reference and distance). - or - TURN LEFT/RIGHT (number) DEGREES IMMEDIATELY TO AVOID [UNIDENTIFIED] TRAFFIC AT (bearing by clock-reference and distance).

## *Expectation Bias*

Expectation bias [6] contends that when someone expects one situation they are less likely to notice cues indicating that the situation is not quite what it seems. Expectation bias is worsened when people are required to integrate new information that arrives piecemeal over time in incomplete, sometimes ambiguous, fragments.

NAV CANADA does provide exposure to this bias to controllers during initial simulator training and the controller was familiar with this bias and how it can result in operating irregularities.

# *Analysis*

The controller was faced with a complex situation when taking over the position, in that there were several flights arriving and departing from the Fort McMurray airport with severe thunderstorm activity south and west of the airport requiring deviations.

The plan chosen by the controller to provide separation for the three arriving aircraft, AM 304, CPB 502, and WJA 255, was to allow for deviations as required and to maintain separation vertically.

---

6 Benjamin A. Berman and R. Key Dismukes, Ph.D, "Pressing the Approach." Flight Safety Foundation, Aviation Safety World, December 2006

Vertical separation was inadvertently discontinued by the controller when WJA 255 was cleared to an altitude below AM 304's before WJA 255 had passed AM 304. This was most likely a result of the controller concentrating on maintaining vertical separation between WJA 255 and CPB 502 until WJA 255 overtook CPB 502. The controller's plan to maintain separation was built upon the expectation of a particular rate of descent by AM 304 and the expectation that its track displayed on the radar display would be maintained. To achieve this goal, AM 304 would have needed to descend at a minimum rate of 1160 fpm. From past experience with this particular aircraft type and company, the controller expected AM 304 to descend at 1500 fpm.

For undetermined reasons, changes from the expected descent rate of AM 304 and changes in aircraft headings were not noticed by the controller. As a consequence, the impending loss of vertical separation went unnoticed until WJA 255 called level at 9000 feet asl, which drew the controller's attention to AM 304's altitude which, at the time, was 9300 feet asl. Compounding this expectation was the controller's assumption that WJA 255 and AM 304 would maintain their parallel tracks although clearances to deviate as required were given. The controller had not placed any restrictions or request for notification of aircraft heading changes, with the result that the only safety net was close and continuous monitoring of aircraft progress. Even momentary diversion of attention to other tasks can result in missed cues that the situation is not evolving in the expected manner.

When the RA to climb was issued by the TCAS software in WJA 255, the flight crew did not advise air traffic control whether they were performing a TCAS climb or descent. This was most likely due to the flight crew's workload dealing with a medical situation on board their aircraft at the time of the TCAS RA command. As a consequence, the controller's action to regain separation by climbing AM 304 delayed the reinstatement of vertical separation as both aircraft were climbing. Had the controller been aware of the TCAS manoeuvre being performed, a better instruction to AM 304 could have been given, resulting in a more rapid regaining of vertical separation.

Safety alert phraseology was not used when AM 304 was instructed to climb. Use of safety alert phraseology by controllers typically provides flight crews with a better awareness of a situation and the opportunity to regain separation sooner.

A number of factors could have served as additional distractions for the controller during this busy time. However, it could not be determined how these factors played a part in the controller's ability to monitor the situation developing during the descent:

- The shift supervisor had plugged into the console and was about to perform an OTS check.

- The controller had been training in the Yellowknife sector for most of the shift. The investigation was unable to determine how working in the Yellowknife sector just prior to moving to the McMurray sector could have affected performance.

- The supervisor was discussing an issue with the data controller at the time of the loss of separation.

While the ATC MANOPS is directed to air traffic controllers and the AIM's primary audience is pilots, there is an area of incongruence between the two in regards to ACAS/TCAS RAs. The ATC MANOPS prohibits controllers from issuing control instructions that "would contradict an aircraft's resolution advisory or warning." The AIM informs pilots that controllers "should not attempt to modify the aircraft fight path until the pilot reports returning to the terms of the existing ATC instruction or clearance". Resolution advisories consist of either a climb or a descent. The ATC MANOPS could be interpreted such that controllers could issue instructions to alter an aircraft's heading because they are not contradicting the RA. Pilots are informed not to expect controllers to alter their flight path, which is broader in application and more aligned with the international practice in DOC 4444 of the ICAO.

Moreover, the ATC MANOPS requires controllers to "provide relevant traffic information and collision avoidance advice…" As to what constitutes advice in this context is unclear, and the ATC MANOPS does not provide guidance on the circumstances, conditions, or limitations in which this advice is to be given. The controller's recent recurrent training on TCAS may have confirmed in the controller's mind that the turn instruction constituted advice allowed under MANOPS 127.2.

## *Findings as to Causes and Contributing Factors*

1. The controller issued clearances to deviate as required, without restrictions, to three aircraft that were descending for the same runway and were in relatively close proximity to each other.

2. The controller's plan for separation was not adequately formulated at the time descent was issued to ensure required separation was maintained.

3. A loss of separation occurred when AM 304 altered heading to the left and the distance between the two aircraft decreased to less than the required five nautical miles or 1000 feet.

## *Findings as to Risk*

1. The fight crew of WJA 255 did not identify the type of traffic alert and collision avoidance system (TCAS) resolution advisory (RA) manoeuvre being performed, resulting in a delay in the regaining of separation.

2. The controller issued a turning instruction to WJA 255 while it was performing a TCAS manoeuvre.

3. When the instruction to climb to 10 000 feet above sea level (asl) was given to AM 304, the controller did not use the A*ir Traffic Control Manual of Operations* (ATC MANOPS) safety alert phraseology, which would have conveyed a degree of urgency.

4. During the TCAS manoeuvre, the controller did not provide traffic information to either aircraft, thus depriving the pilots of information from which they could have taken more assertive action.

## *Other Finding*

1. The A*ir Traffic Control Manual of Operations* (ATC MANOPS) does not provide controllers with any guidance as to how and under what circumstances collision avoidance advice is given.

## *Safety Action Taken*

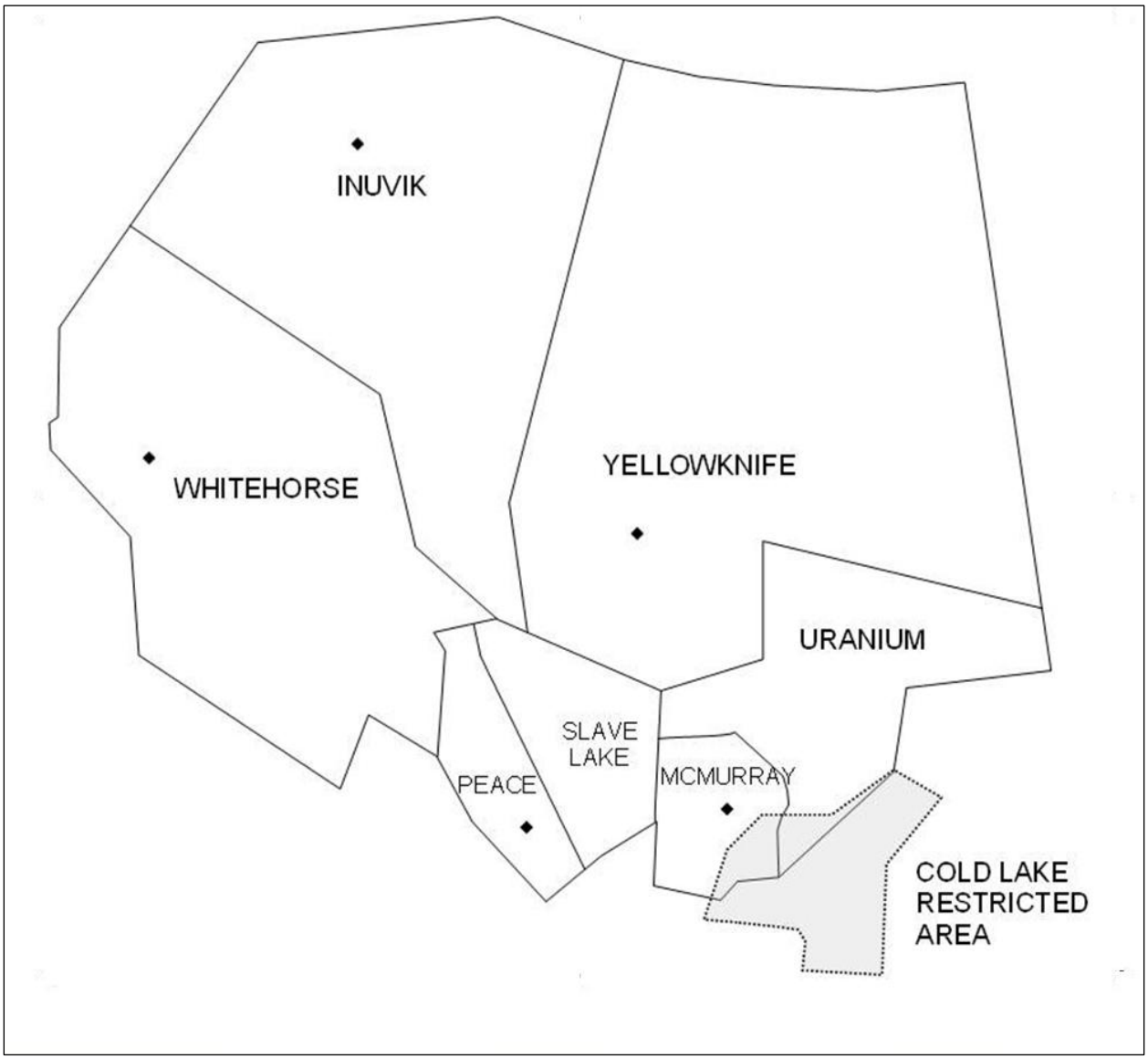
NAV CANADA will amend the A*ir Traffic Control Manual of Operations* (ATC MANOPS) direction to better reflect the intent of International Civil Aviation Organization (ICAO) Document 4444 as follows:

> ATC MANOPS 127.2 - Provide relevant traffic information and collision avoidance advice as appropriate to an aircraft under your jurisdiction if you are advised by the aircraft that it is responding to an ACAS/TCAS resolution advisory or GPWS/TAWS warning. Do not attempt to modify the aircraft flight path until the pilot reports returning to the terms of the current air traffic control instruction or clearance.

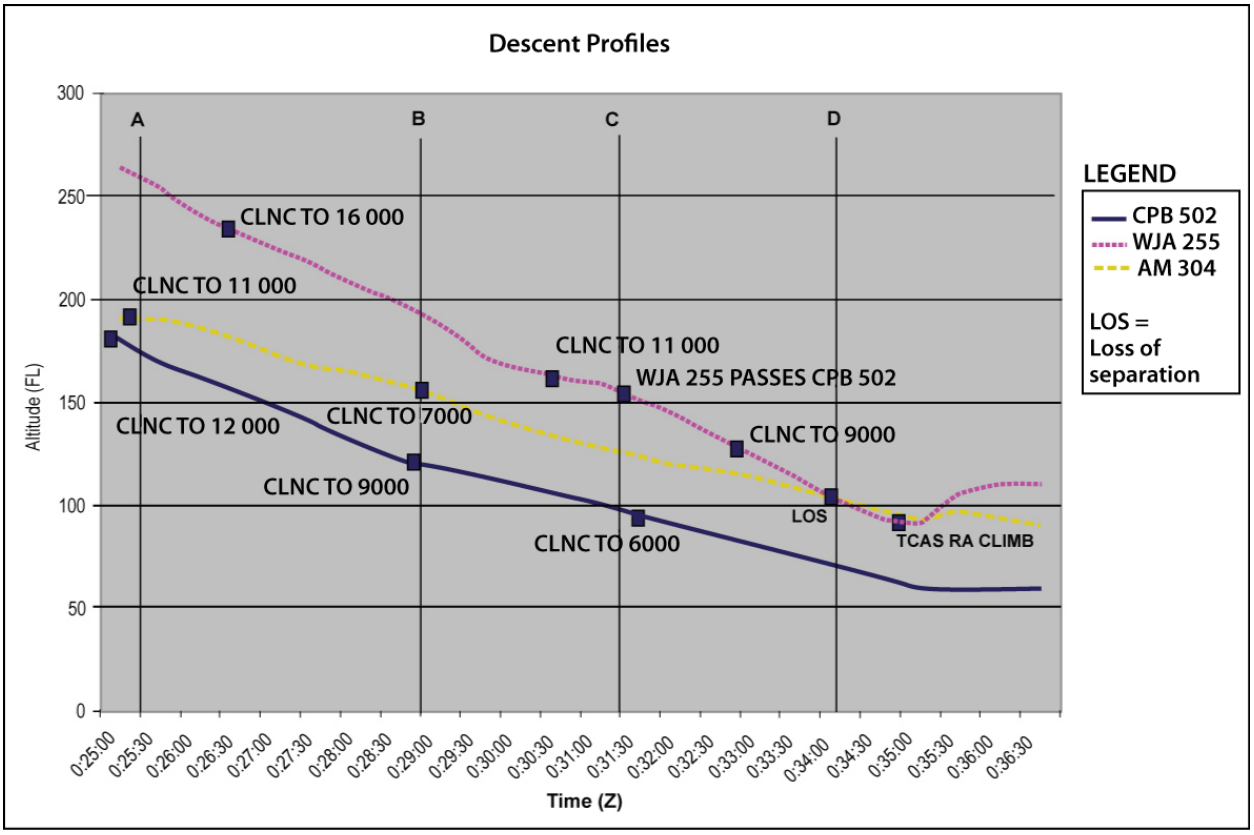
*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 21 May 2009.*

*Visit the Transportation Safety Board's Web site (**www.tsb.gc.ca**) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.*

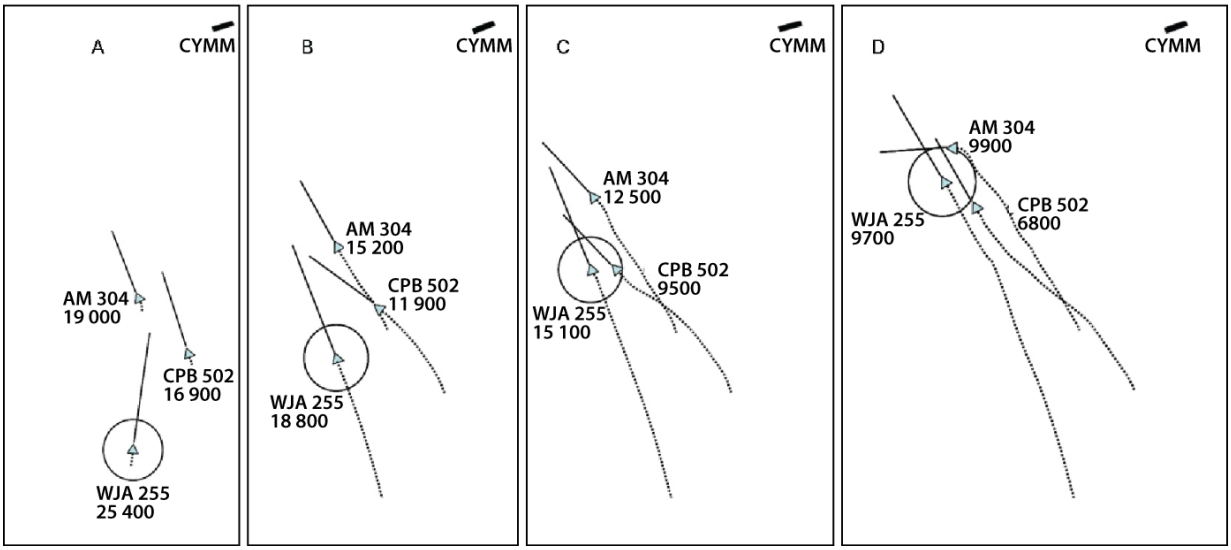
*Appendix A – North Low Sector Map – FL 290 and Below*



# *Appendix B – Descent Profiles*



# *Appendix C – Plan Views*




The circle around WJA 255 represents five nautical miles. The projected track lines for each aircraft represents three minutes and the altitudes are in feet above sea level. The letters A, B, C, and D correspond to the areas identified on the descent profile in Appendix B.